Muon Cryosystem Design Note #27

SUBSYSTEM: X CCM CVM Cryoplant

TITLE: Addition of Pos-a-set Disks to CCM Vent

AUTHOR: R.I. Dachniwskyj

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Objective of Note

To demonstrate how a Pos-a-set rupture disk made by Continental Disk Corporation can make a rupture disk insensitive to back pressure.

Discussion

Currently the CCM helium space is protected by two 4-inch Fike rupture disks which are set to rupture at 11.7 psid. A Pos-a-set rupture disk will soon be installed above each one of the existing rupture disks in it's own holder. Between the two rupture disks there will be an opening (a small orifice) to assure that the pressure between the two disks will be the same as the building pressure.

The purpose of the Pos-a-set is to insure that both Fike disks will rupture at a cryostat pressure of 11.7 psig and not a higher pressure due to back pressure in the vent pipe. Figures 1 and 2 show how the Pos-a-set is assembled and installed. The vacuum pressure rupture setting will be 15 psi and the positive pressure rupture setting will be 30 inches of water (1.08 psi), therefore the Pos-a-set can withstand large back pressure, but it does not need to see a large positive differential pressure to cause the disk to open.

The maximum rupture pressure for the Fike rupture disk is (1.05) (11.7) = 12.29 psi. The pressure drop in the vent line is small (3.3 psi), per the Director's Exemption document for CCM, therefore the positive differential pressure will be much larger than required to open the Pos-a-set. The available minimum positive differential pressure is (11.7) (0.95) - 3.3 = 7.82 psi, which is much larger than the required positive differential pressure to open the Pos-a-set fully of 36/27.681 = 1.30 psi.

The orifice in the space between the disks will be small, approximately 1/16 inch in diameter. The amount of helium gas vented into the room per opening is ≈ 22 SCFM. This is equivalent of venting an entire helium gas cylinder in 12-1/2 minutes. This is a small quantity of gas which will quickly migrate to the ceiling and be vented out through the roof louver that is located south of CCM.

There is one failure mode which could possibly cause the Pos-a-sets to rupture prematurely: if the area is experiencing a record high barometric pressure then suddenly a record low front moves in, and the building louvers can not accommodate the change in the pressure sufficiently quickly. According to the National Weather Bureau the highest recorded barometric pressure in this area is 30.90 inches of Hg and the lowest recorded barometric pressure is 28.70 inches of Hg, therefore if these two record barometric pressures occurred one after another the difference would be 2.2 inches of Hg or 29.9 inches of water. This would be enough to possibly cause the Pos-a-set to rupture. This failure mode is sufficiently improbably that it does not concern us.

Conclusion

1. Rupture disks can be made insensitive to back pressure with the addition of Pos-a-set disks from Continental Disk Corporation.

2. The small opening between the Fike rupture disk and the Pos-a-set does not produce an ODH problem.

3. The system is fail safe as long as there is no freak weather system that moves across the area and the building louvers fail to function as designed.

Reviewed By

R W Fast 6-10-86

INSERT-TYPE POS-A-SET® RUPTURE DISC ASSEMBLY

for installation between 150# flanges with ANSI bolting

DESIGN FEATURES

PATENTED GIRDLE (Teflon or SS) determines standard min-max vacuum settings, allows system to operate within 1" water column of minimum vacuum pressure rated setting.

PERFORATED METAL SECTION will give vacuum relief at a set rating.

TEFLON SEAL distributes pressure uniformly in both positive and vacuum directions, eliminates both external and internal leakage. Optional B.D.I. Burst Disc Indicator strip is applied to seal when rupture disc is to be incorporated in a rupture disc alarm system. A **TEFLON SLOT COVER** placed on top of the seal protects the seal from burrs in the metal top section.

KNIFE BLADES with PRECISION-HONED EDGES are designed to provide maximum positive pressure relief.

FLAT SEAT DESIGN reduces susceptibility to product buildup, promotes easier cleaning to meet FDA requirements.

LOCATER PINS on outlet Safety Crown holder assure proper disc alignment.

INSERT TYPE DESIGN permits thinner flanges, reducing weight and material cost.

NO MOVING PARTS eliminates possibility of mechanical malfunctions, assures fail-safe operation.

See Pages 10 and 11 for RANGES OF POSITIVE PRESSURE AND VACUUM RELIEF, MATERIALS OF CONSTRUCTION and DIMENSIONS.

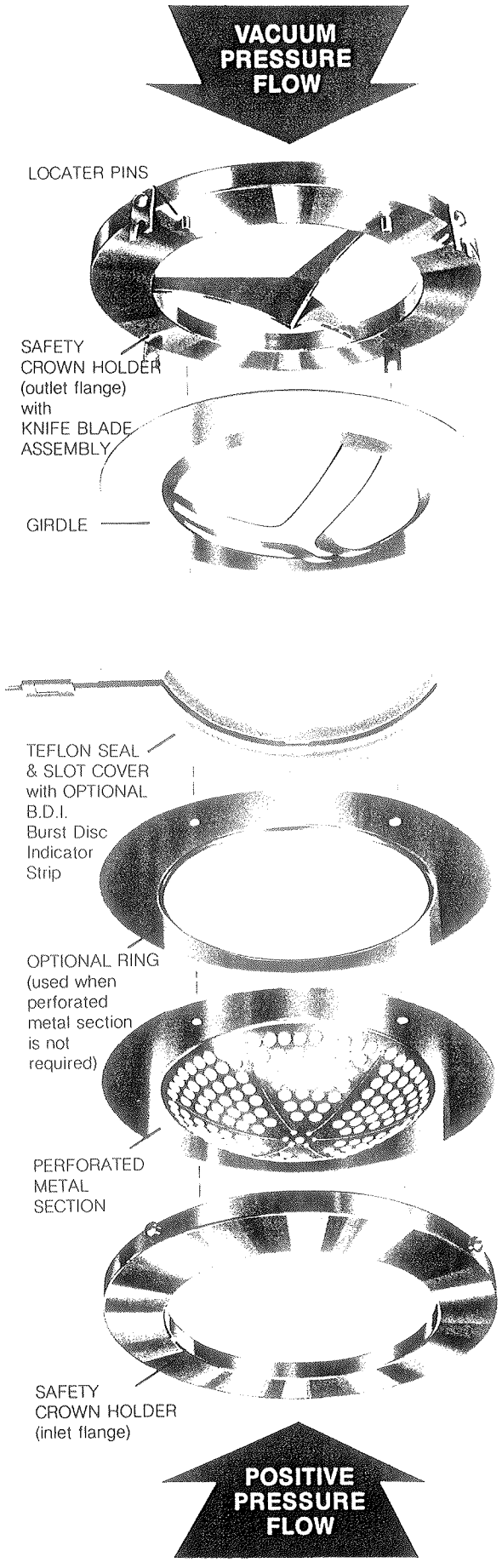
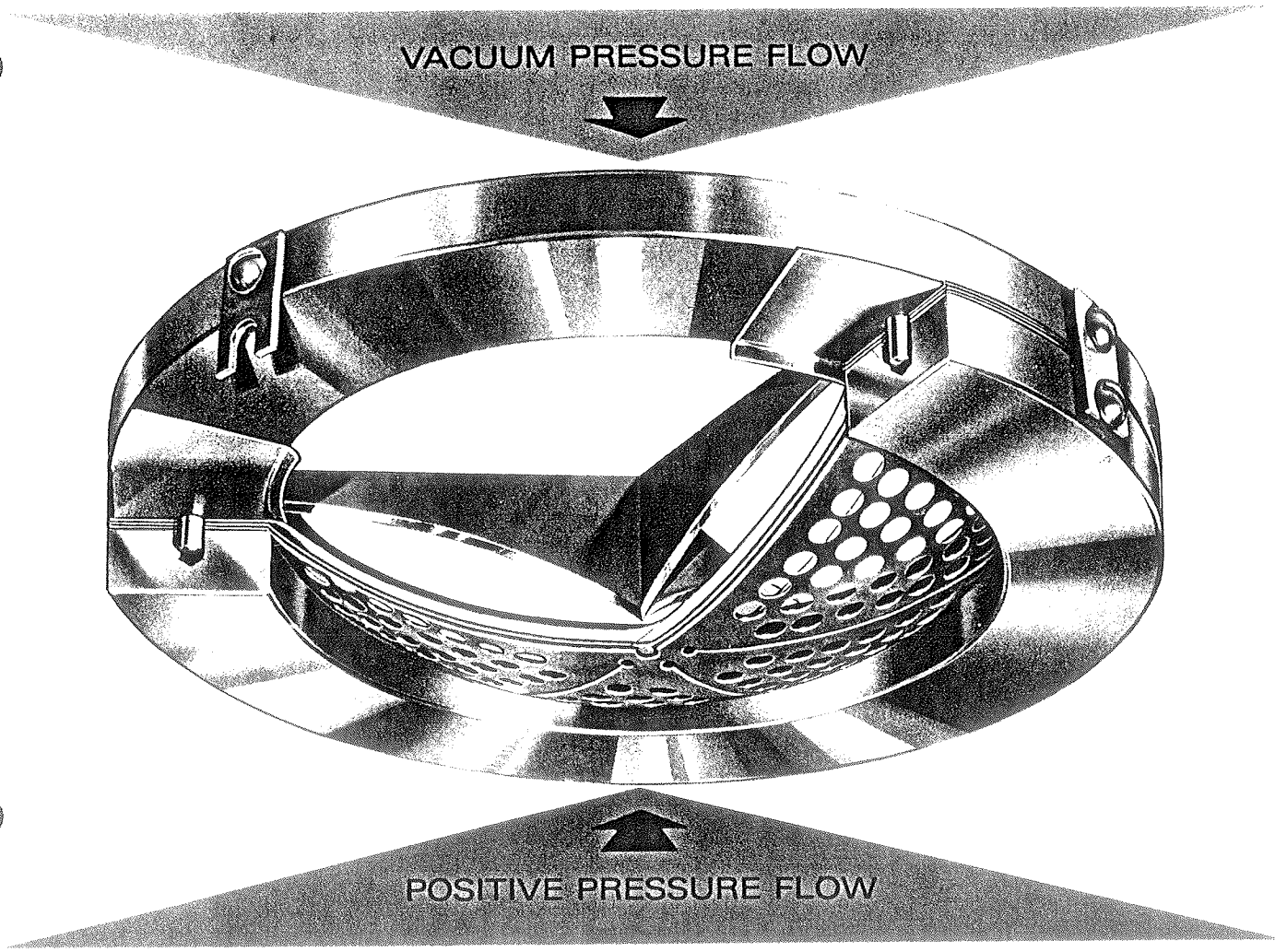


FIG 1 EXPLODED VIEW OF A POS-A-SET RUPTURE DISK



HOW THE POS-A-SET RUPTURE DISC WORKS

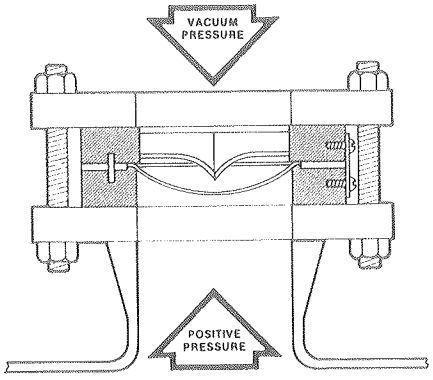
As positive pressure in the system approaches the rupture pressure rating, the girdle becomes loaded until it deflects back through the knife blades located in the outlet holder The seal deflects with the girdle. As the girdle and seal pass through the blades, the seal is penetrated at the touch point, then cut in a triangular pattern to relieve the positive pressure.

The perforated metal section, which enables the rupture disc to relieve pressure from the negative (vacuum) direction, is also designed to allow optimum flow through the disc when relieving in the positive pressure direction

DISC REPLACEMENT

When POSITIVE overpressure relief occurs, if a Teflon girdle is used normally only the Teflon seal needs to be replaced. If a stainless steel girdle is used both the girdle and seal must be replaced.

When NEGATIVE pressure (vacuum) relief occurs, all components of the rupture disc assembly (Safety Crown holders excepted) must be replaced.



INSERT-TYPE POS-A-SET RUPTURE DISC ASSEMBLY properly installed in a pressure system

FIG 2. ASSEMBLED CUT-AWAY OF A POS-A-SET RUPTURE DISK